MICHIGAN ENVIRONMENTAL SCIENCE BOARD

LOW LEVEL RADIOACTIVE WASTE PANEL
MEETING SUMMARY
TUESDAY, FEBRUARY 20, 1996
PARK INN INTERNATIONAL
HOWELL, MICHIGAN

PANEL MEMBERS PRESENT
Dr. Bette Premo, Acting Chair
Mr. James Carey
Dr. David Morrissey
Dr. Conrad Nagle
Mr. Keith Harrison, Executive Director

DMB/EAD SUPPORT STAFF PRESENT
Ms. Sharon Picard, Financial Officer
Ms. Patricia Hiner, Secretary

I. CALL TO ORDER

Mr. Keith Harrison, MESB Executive Director, called the meeting of the Low Level Radioactive Waste Panel to order at 9:00 a.m. Mr. Harrison made a brief report on several administrative matters. Dr. Bette Premo took charge of the meeting upon her arrival.

II. PUBLIC COMMENT

Mr. Thor Strong, Michigan Low-Level Radioactive Waste Authority, provided a summary of the Low Level Waste Forum he had recently attended. He indicated that he would review the information obtained from the meeting and provide the Panel with a copy of the pertinent material.

Terry Gill, Michigan Low Level Radioactive Waste Board of Governors, inquired why U.S. Ecology was chosen as a source of information to the Panel when it is her belief, that they have a very poor track record. Mr. Harrison stated that during the course of any MESB investigation, its Panels are typically supplied with solicited and unsolicited information from a variety of sources, including government, industry, advocacy groups and private citizens. All the material is reviewed and evaluated by the Panel members based on its scientific merit. Mr Harrison indicated that any additional data that Ms. Gill would like to provide to the Panel would be welcomed.

Mary Johnson raised concern over the disposal of commingled low and high level radioactive waste, and that taxpayer money was very possibly being spent to service the disposal of this waste for the nuclear industry. Ms. Johnson indicated that she would supply the Panel with data documenting the commingling.

Harold Stokes expressed similar concerns regarding the commingling of low and high level of radioactive wastes. He also expressed concern regarding the Panel's assignment, questioning the appropriateness of focusing solely on the directives forwarded in an assignment, when there are possibly other very important and pertinent issues to the citizens of Michigan. Ms. Johnson followed by indicating that she has not seen an adequate definition of the problem, and believes the Panel was using the directives issued by the Governor's office as a way to avoid addressing the real issues.

Dr. Morrissey responded that there are formal definitions of low and high level radioactive wastes established by the U.S. Nuclear Regulatory Commission (USNRC) which are fairly clear-cut. Further, the task before the Panel is to determine what to do with the radioactive waste produced in Michigan, regardless of its source. It is not to question the ethics of the nuclear industry. Mr. Harrison added that while he appreciated the concerns raised by Ms. Johnson and Mr. Stokes, the Panel would need to continue to address the charges given to it unless directed otherwise by the Governor.

III. PRESENTATIONS

Dr. Carol Hornibrook (Electrical Power Research Institute - EPRI) discussed the importance of waste forms in the disposal of low level radioactive waste. A summary of the presentation and a copy of the overheads used are contained in Attachment 1.

Mr. Carey indicated there had been a discussion of reducing the allowable intruder dose to 100 mrem and that 10CFR61 was to be amended to include the USNRC's 10 mrem airborne dose, as well as other changes. Dr. Hornibrook said there was some discussion to that effect, but that nothing had changed in terms of the regulations.

Mr. Carey asked whether chunks of radioactive metal, which are more concentrated than the general waste, have been taken into account in the USNRC scenarios. Dr. Hornibrook responded that the USNRC has come out with a new concentration averaging scheme in an attempt to take that into account.

Dr. Morrisey said that Dr. Hornibrook's presentation seemed to concentrate more on shallow land burial than engineered facilities. Dr. Hornibrook replied that the regulations were originally developed for shallow land burial, but are considered, by the USNRC, to apply equally to engineered barriers. It is also important to remember that engineered barriers will not last as long as the long-lived nuclides.

Dr. Premo asked if Class A waste can be put into unregulated facilities because of its low level of activity. Dr. Hornibrook said that while it does not have to be stabilized, it still needs to be disposed of in a regulated facility.

Mr. Harrison asked whether there is a chance of industry developing facilities for Class A waste only. Dr. Hornibrook responded that industry is more interested in Class B and C waste disposal.

Mr. Harold Stokes asked what percentage of waste is incinerated. Dr. Hornibrook said that it ranges from 25% to 50% for Class A wastes. However, the transuranics are not volatile and are captured in the system or in the ash itself. Mr. Stokes pointed out that C-14 is also introduced in incineration. Dr. Hornibrook replied that the small amounts released from incinerators are a very small contribution compared to the amount of C-14 that is circulating naturally in the atmosphere. Class B and C wastes are not being incinerated.

Terry Gill asked whether the USNRC mandates specific models to be used in performance assessments. Dr. Hornibrook said that there are about five models available, a few from the USNRC, one from the USEPA, and another from Canada. They are all fairly similar. Licensees select the code to use, the USNRC has to approve the selection, and the code has to be made public.

Ms. Kristin Erickson (Radiation Safety Officer, Michigan State University - MSU) discussed the applicable regulations for low level radioactive waste management. A summary of her presentation and a copy of her handout are contained in Attachment 2.

Mr. Strong inquired about C-14 disposal by incineration. Ms. Erickson stated that all LLRW wastes, including C-14, which are incinerated at MSU, are kept well below the release limit for the general public. MSU does not depend on exhaust dispersion pattern models and calculations, which are too unpredictable to meet applicable standards.

Dr. Premo asked if MSU monitors its discharge to the sewage treatment plant. Ms. Erickson indicated that it does by calculating the dilution rate and staying well below the requirements for the standard and composite 24-hour water samples and one-half hour sludge grab samples.

Mr. Carey inquired about the number of laboratories that use radioactive materials and the longest-lived isotope used at MSU. Ms. Erickson indicated that MSU has 250 approved facilities (700 rooms) and that C-14 was the longest-lived isotope used.

Mr. Harrison asked if Ms. Erickson considered the LLRW management operation at MSU as typical compared to the operation at other Michigan LLRW storage sites. Ms. Erickson indicated that MSU's program is one of the larger operations in the state. It is also probably one of the better run due to its aggressive training component and its computerization and other waste and health tracking enhancements which have been instituted over the years.

IV. PANEL DISCUSSION

Dr. Premo moved the discussion to address the Panel's need to have questions addressed, obtain additional data or request additional speakers for future Panel meetings. In particular, she asked if the Michigan Low Level Waste Authority can find out how many waste storage licenses are presently active in Michigan, and the amount and kind of waste the facilities are generating and possibly storing. Mr. Stong indicated that he would see if any additional information could be obtained beyond what his agency has previously provided.

Dr. Morrissey stated that it was important for the Panel to receive the performance assessment report that compares the models. Mr. Harrison indicated that he would try to obtain a copy for the Panel.

V. PANEL ASSIGNMENTS

Dr. Premo asked the Panel members to briefly comment on the progress of their responses to the Governor's directives.

Mr. Harrison and Dr. Morrissey informed the Panel that they, along with Dr. David Long, were responsible for responding to the first directive from the Governor (whether Michigan's environment and/or geology pose unusual or unique conditions that would not be fully recognized, evaluated and protected under federal facility siting regulations and performance assessment standards. They stated that, presently, they were in the process of developing a matrix which would compare Michigan's siting criteria with those of other states and the federal performance criteria). Additionally, Dr. Long is in the process of reviewing the data concerning the unique environmental/geological concerns of Michigan.

In regards to Directive 2 (to determine if any of Michigan's siting criteria are unwarranted), Mr. Carey questioned whether 10CFR61 was the only federal regulation to be evaluated, or should the Panel also evaluate the USNRC performance assessment standards. Mr. Harrison indicated that the Panel will need to look at both. The assessments were conducted on a series of models, the basis of which is an area of concern to the Panel. The Panel will need to obtain copies of the various models in order to allow it to review various assumptions used in them. Dr. Hornibrook stated that a review of the codes is available which outlines the differences and offers individual summaries. She indicated that she would provide the name and telephone number of the contact person for a copy of the report to the Panel.

Mr. Carey indicated that a response to Directive 3 (to determine if an engineered LLRW isolation facility could be located in Michigan without posing dangerous levels of radioactive risk to public health and safety and/or the environment), would be dependent on the Panel's responses to Directives 1 and 2 and on the state of the art of the design and building of isolation facilities. He stated further that if a facility can be run under the exposure levels listed in 10CFR61, and if it can be built and stay within the very low limits called for in 10CFR61, then the answer to Directive 3 will probably be yes.

Dr. Premo stated that Directives 4, 5, and 6 all deal with the relative risk of storing LLRW at facilities compared to the storing of such material at a centralized engineered isolation facility. Thor Strong explained that until July 1995, the state did not have a waste isolation facility available to send its LLRW, but presently some companies; mostly nuclear power facilities, have begun shipping such waste to the facility in Barnwell, South Carolina.

Mr. Harrison asked if Mr. Strong could expedite the survey of the state's waste storage facilities for 1995. Mr. Strong indicated that he was not certain how soon the 1995 survey would be ready to be sent out. Dr. Morrissey suggested that having a list of the isotopes, by type, quantity, and half-life, currently being stored at the generator facility would be useful from the survey.

Mr. Carey and Dr. Premo commented that the temporary storage of these materials in buildings that are not specifically engineered to handle such waste is of concern and deserving of the high or medium to high ranking received in the Michigan Relative Risk Report.

VII. NEXT MEETING DATE

No date was set for the next meeting of the Panel.

VIII. ADJOURNMENT

The meeting was adjourned at 3:00 p.m.

Keith G. Harrison, M.A., R.S., Cert. Ecol.
Executive Director
Michigan Environmental Science Board

Michigan Environmental Science Board
Telephone: 517-373-4960
Fax: 517-373-6492
E-Mail: mesb@state.mi.us
Web Address: http://www.great-lakes.net/partners/mesb/mesb.html

ATTACHMENT 1. Presentation by Dr. Carol Hornibrook, Electrical Power Research Institute.

Dr. Hornibrook indicated that her position at the Electric Power Research Institute (EPRI) is that of head of the Low-Level Radioactive Waste Research Group. EPRI is funded by utilities across the country and conducts research on various aspects of energy, from fossil fuels to solar.

The waste classification in 10CFR61 (Licensing Requirements for Land Disposal of Radioactive Wastes) was implemented in 1983 and requires that low level radioactive waste be classified in accordance with a "for disposal" classification scheme. The regulation is not concerned with the exposure to the person handling the waste, but rather with how it will become available or interact with the public once it is in the ground. Classification depends on concentrations of short-lived and long-lived radionuclides in the waste compared to the limits that are established in the regulations. The radionuclides the USNRC considers important to land disposal are H-3, C-14, Co-60, Ni-59, Ni-60, and Sr-90. These are the nuclides that have to be taken into consideration in performance assessments. Once the concentrations are determined, the classification scheme requires that the waste be classified to determine the specific protective measures necessary. In summary, 10CFR61's approach is to segregate Class A waste, to provide intruder protection for Class B and C wastes, and to provide additional site stability and intruder protection for Class C waste.

Low level radioactive waste is divided into classes A, B, and C. Most waste generated is Class A, which has the lowest content of radioactivity. The USNRC regulations do not require Class A waste to be solidified or stabilized, as long as regulatory concentration limits are met. Class A waste, being composed predominantly of short-lived nuclides, contributes almost no dose to the public. The majority of Class A waste is dry active waste - paper, protective clothing, some wood, mop heads, and other articles used around the power plant. There are also some resins. It is not worth the effort to stabilize Class A waste since stabilization only reduces the dose to the public from .111 mrem per year to .109 mrem per year. There is less Class A waste generated now than in the past, since the utility industry does a better job of incinerating and other processing of these materials. In the past instability at disposal sites attributed to Class A waste, was due to the fact that such wastes were not well processed. Currently, a lot less biodegradable material is used and processing has made the waste itself much more stable.

Federal regulation 10CFR61 requires that Class B waste be in a stabilized form, either the waste itself or its package. It is either stabilized or put into a high integrity container, lasting about 300 years. Class B waste is primarily resins and filters; approximately 18% by volume of the total waste generated.

Class C waste must be in a stabilized form, plus stored with an intruder barrier. It consists of resins and some activated metals, and by volume is about 2% of what is generated.

Dose limits have been established by the USNRC. Annual exposures of 25 mrem to the entire body, 75 mrem to the thyroid, and 500 mrem to the inadvertent intruder are allowed. In terms of the performance assessment in meeting those dose limits, the important pathway scenarios in 10CFR61 are the groundwater and intruder scenarios, which are the main scenarios for exposure to Class B and Class C waste.

There are actually three intruder scenarios - construction of a house, discovery of the waste the construction is into and subsequent abandonment, and intruder agriculture, where the house is lived in and people are drinking and eating materials grown in the soil from the site. There are also several groundwater scenarios. The USNRC has developed mathematical models representing exposure conditions in these scenarios. Dose pathways for the major long lived radionuclides are predominantly food uptake and inhalation. For the shorter lived radionuclides food uptake, inhalation and direct gamma rays are the predominant exposure pathways.

In the intruder construction scenario, the USNRC assumes that an intruder digs a basement with dimensions 10 meters by 20 meters, for an average 2,000 square foot house. The excavation is three meters deep and the person is exposed for 500 hours. The exposure is from direct gamma rays from the nuclides in the soil-waste mixture and also inhalation of nuclides re-suspended by the excavation activities, which are short-lived gammas and transuranics. The intruder discovery scenario assumes the same structure dimensions. However, the intruder digs for six hours, then discovering that there is something strange about the material being dug up, terminates the excavation to determine what it is. The intruder agriculture scenario assumes that the individual lives in the house that has been built on the waste site, that 50% of the food consumed by the individual is taken from contaminated soil, and the exposure is 6,180 hours a year. The actual exposure is from direct gamma radiation from excavated soil, inhalation of nuclides suspended naturally in transuranics, and ingestion from food grown in contaminated soil. In the intruder scenarios it is important to remember that barriers are assumed to be effective for 500 years. At the end of that time a reduction factor of 10 is applied to the Class C waste dose projection, assuming that the soil will account for some dilution of the waste.

The groundwater scenario assumes that rain water infiltrates the trench or vault, sits in the waste material and leaches out nuclides from the waste. The infiltration water then passes out of the disposal unit and intercepts the underlying aquifer. When the well water is used for drinking, crop irrigation and livestock watering, humans are exposed by ingestion. The groundwater dose is controlled by the long-lived radionuclides, not short-lived, as is the intruder dose. The dose will depend on the water infiltration, the release rate, and distance from the waste to the well.

Waste form and/or barriers give only limited protection for critical radionuclides. Groundwater doses are often dominated by long-lived nuclides, such as C-14, I-129 and Tc-99. Waste forms and barriers can have some effect on shorter lived 5,000 year C-14 because its peak is a thousand year time frame. But such radionuclides as I-129 and Tc-99, which have much longer half-lives -10,000 years, are not affected much by waste form. These really have to be controlled by limiting the waste inventory.

Based on ongoing research, it is no longer considered the case that groundwater dose is dominated by I-129 and Tc-99. Rather, research suggests that C-14 is the controlling radionuclide. Current models do not take into account any of the gaseous releases from C-14. They also assume that all activity goes into the groundwater. But C-14 is probably released in both organic and inorganic forms, which makes a difference in how and to what degree the nuclides are available. EPRI contends that the resulting groundwater doses may be overestimated because of the misunderstanding of C-14 in 10CFR61. EPRI has published a preliminary report on this issue, and expects to clarify the issue in the near future.

Waste form has limited benefit in terms of intruder dose. It is useful for Class B waste because the waste form will hold up as long as the shorter-lived waste, but not as long as the longer transuranics. The federal regulation 10CFR61 proposes that a deeper burial of the waste will keep it away from the intruder. The regulation also limits the concentration of long-lived nuclides in the waste itself, which will result in an average transuranic concentration in reactor waste that will lead to less than a 500 mrem dose.

The important concepts to come out of 10CFR61 are that the waste form is important to terminate the intruder construction scenario for Class B waste since (1) the level of transuranics is very low; (2) the waste form has a finite life when compared to the half-lives of many of the radionuclides that are contained in Class C, and these longer-lived radionuclides will outlast most waste forms; and (3) the protection features beyond waste form, like deeper burial, are required for Class C waste.

Dr. Hornibrook disagrees with 10CFR61 that concrete barriers are as effective as deeper burial. She also disagrees with the emphasis on site stability features, since they also have a finite life when compared to the half-lives of radionuclides of interest in the groundwater scenario. Another area of disagreement is that the 10CFR61 analysis of groundwater doses takes credit for waste form and site design features. For time periods of 10,000 years and greater, these factors cannot be relied upon for protection.

Presentation Overheads

WASTE CLASSIFICATION:

- 10CFR61 Licensing Requirements for Land Disposal of Radioactive Waste;
  Implemented, December, 1983
  Requires that low level waste be classified in accordance with a “for disposal” classification scheme.

The classification depends on the concentrations of short-lived and long-lived radionuclides in the waste compared to limits established in 10CFR61.

- 1OCFR6l radionuclides important to LLRW disposal;

  H-3, Nb-94, Transuranics (TRU), C-l4, Tc-99 , Pu-238, Cm-242, Co-60, I-129, Pu-239, Cm-243, Ni-59, Cs-l37, Pu-24I, Cm-244, Ni-60, Am-24l, Sr-90.

- Classification scheme in 10CFR61 requires waste be classified to determine the protective measures that need to be taken (Waste Classes).

  A. No waste form requirement (Predominantly Dry). No site design requirement except must be segregated from B & C if not stabilized (Active waste - paper protective clothing, etc. - 80%)

  B. Waste must be in stabilized form, either the waste itself or the package (Predominantly resins and filters - 18%)

  C. Stable waste form plus site design requirements for an intruder barrier (Predominantly resins, filters and activated metals)

Table 1: Long-lived Nuclides

Radionuclide	Half-live (yrs)	Radiation Type	Dose Pathway
C-l4	5730	Beta	Food Uptake
N1.59	76000	x-rays	Inhalation
Nb-94	2000	Beta/gamma	Direct Gamma
Tc-99	213000	Beta	Food/lnhale
1-129	2E+07	Beta	Food/lnhale
Pu-238	87.7	Alpha	Inhalation
Pu-239	24100	Alpha	Food/lnhale
Pu-241	14.4	Beta	Inhalation
Am-24l	432	Alpha	
Cm-242	0.44	Alpha	
Cm-243	28.5	Alpha	
Cm-244	18.1	Alpha	

Table 2: Short-lived Nuclides

Radionuclide	Half-live (yrs)	Radiation Type	Dose Pathway

H-3	12.3	Beta	Water & Food Uptake
Co-60	5.3	Beta/gamma	Direct Gamma
NI-63	100	Beta	Food Uptake
NI-63 act. met.	100	Beta/x-ray	Inhalation
Sr-90	29.I	Beta	Food Uptake
Cs-137	30.2	Beta/gamma	Direct Gamma

DOSE LIMITS:

- USNRC's Basis;
  - Established allowable use limits for a maximally exposed member of the public:

    25 mrem/yr whole body
    75 mrem/yr thyroid
    500 mrem/yr inadvertent intruder

  - Identified reasonable ways a human could come in contact with the waste or that radionuclides could be transported to humans.

- Important Exposure Pathway Scenarios

  - Two dominated the dose impacts in 10CFR61's FEIS.

    (1) Intruder, during construction and his discovery and latter agriculture.

    (2) Groundwater

- Exposure/Dose Limits

  -.Exposure pathway scenarios.

    Develop mathematical models that represent the exposure conditions in the exposure scenarios:

      (1) Intruder dose

      (2) Performance assessment

      (3) Then calculate waste concentrations that would likely result in dose impacts less than the limits

EXPOSURE PATHWAY SCENARIOS:

- Intruder Construction Assumptions

- Inadvertent intruder digs a basement for a house into waste trench.

  Basement Dimensions (2000+ sq. ft house)
  Depth of Excavation = 3 m
  Duration of job or exposure = 500 hrs.

- Exposures result from:
-
  - Direct gamma from nuclides in the soil/waste mixture

  - Inhalation of nuclides re-suspended naturally and by excavation activities

- Intruder Discovery Assumptions

  - Same as intruder construction scenario, except:

    When intruder digs into a waste form, that is other than natural soil, the person terminates his/her excavation after 6 hours. Six hours is based on intruder recognizing that what's being dug up is not natural material and that he/she, (1) should stop and (2) find out what it is.

  - Exposure is reduced by a factor of 83 from the 500 hour construction scenario.

- Intruder Agriculture Assumptions

  - Inadvertent intruder is an individual that lives in a house built in the intruder construction scenario.

  - Important characteristics assumes:

    Chronic Exposure

    Exposure duration 6180 hrs/yr
      Direct gamma from excavated soil distributed around the house
      Inhalation of nuclides

    50% of food consumed is from contaminated soil
      Ingestion of food grown in distributed soil

- Important Characteristics of Both Scenarios

  - Intruder barriers are assumed to be effective for 500 years

- At the end of 500 years, a reduction factor of 10 is applied to Class C waste dose projections - this accounts for greater dilution of these wastes by (1) deeper disposal or (2) limited exposure duration because of access.

- Groundwater Scenario Assumptions

  Rainwater infiltrates waste trench

  Infiltration water leaches nuclides from waste

  Infiltration water passes through waste and intercepts aquifer beneath trench

Well water used for:	Exposure results from ingestion of:
-drinking water	- drinking water,
-crop irrigation	- crops
-livestock watering	- animal products

- Groundwater Dose Discussion

  - Controlled by long-lived radiation:

Because of the long half-lives	I-129	(15.7 million years)
	Tc-99	(213,000 years)
	C-14	(5,730 years)

  - Doses are affected to varying degrees by:

    - Site stability water infiltration
    - Release from waste form
    - Distance to well

  - I-129, Tc-99 are not controlling nuclides in recent disposal facility performance assessments.

  - C-14 appears to be the controlling nuclide.

  - Assume C-14 is in mobile anion form. C-l4 is probably released in organic and inorganic form. Some captured by concrete and/or concrete rubble. CO_2 is also given off. Information is being developed.

  - Current performance assessment models do not account for gaseous release of C-l4 from decomposition of the waste.

  - Groundwater doses are likely to be overestimated because of the above assumptions.

- Important Concepts that Come Out of 1OCFR6l Analysis

  - Recognition that waste form is important to terminate the intruder construction scenario (Class B).

  - Recognition that waste form has a finite life when compared to the half-life of many of the radionuclides (Class C).

  - Recognition that protection features beyond waste form are required for Class C wastes; i.e., barriers or deeper disposal.

- Points To Consider

  1OCFR61 suggests that an intruder barrier; i.e., concrete, is as effective as deeper disposal (Class C waste) [Concrete has a finite life].

  10CFR61 emphasizes site stability features which have a finite life when compared to the half-lives of the radionuclides of interest in the groundwater scenario.

  1OCFR61's analysis of groundwater doses takes credit for waste form and site design features.

  For long time periods (>1O,OOO years) these factors cannot be relied upon for protection.

RECAP OF 1OCFR61 APPROACH

Segregation of Class A waste

Intruder protection required for Class B & C Wastes

Class C wastes require additional intruder protection

Site stability is required for groundwater protection

Limits site inventories

Emphasizes waste form stability enhances site stability (retard water infiltration)

Past problems of subsidence due to:
Poor Packaging of Waste
Compressible Waste
Degradation of Waste

Random Placement
Poor Backfilling
Poor Compaction of Backfill

WASTE FORM STABILITY

- Relative to Class A Waste

  - 1OCFR6I - Waste form stability not required when Class A disposed separately from Class B & C wastes. Waste form stability required when Class A is co-disposed with Class B & C wastes.

  - USNRC analysis of non-engineered site; dose = 0.111 mrem/yr (typical background radiation dose is 350 mrem/yr). Stabilizing all Class A waste reduces public dose to 0.109 mrem/yr.

SUMMARY

- Summary: Class A Waste (waste form stability is unnecessary)

  - USNRC does not require it because accounted for in the Concentration Limits listed in 10CFR61.55 Table 2.

  - Unstabilized Class A waste contributes almost no dose, predominantly Short-lived nuclides in Class A waste

  - Less biodegradable material disposed which decreases potential for site instability.

  - Waste form stability is unnecessary (USNRC does not require it because accounted for in the Concentration Limits listed in 10CFR61.55 Table 2)

  - Unstabilized Class A waste contributes almost no dose (predominantly short lived nuclides in Class A waste)

  - Less biodegradable material disposed (decreases potential for site instability)

- Summary: Class B & C Waste

  Groundwater Dose

  - Limiting site inventories is the ultimate control

  - Waste form and/or barriers buy limited protection for the critical nuclides

(Groundwater doses are dominated by C-l4, I-129 & Tc-99)

Intruder Dose

Waste form has limited benefit

Deeper burial of waste (10CFR61)

10CFR61 limits the concentration of long lived nuclides in waste (Tables 1 & 2)

(Protects intruder from long and short-lived nuclides.)
(Average TRU concentrations in reactor waste result in <500 mrem dose.)

- Concentration Limits in 1OCFR6l.55

Table 1: Long Lived Nuclides

Radionuclide	Concentration (Ci/M3)
C-14	8
C-14 in activated metals	80
Ni-59 in activated metals	220
Nb-94	0.02
Tc-99	3
I-129	0.06
Alpha Emitting Transuranic	(nanocuries/gr)
Nuclides with half-lives <5yrs	100
Pu-241	3500
Cm-242	20000

(These concentrations limits are based on the intruder scenarios and are Class C Waste limits)

Table 2: Short-lived Nuclides (Concentration - Ci/M3)

Radionuclide	Class A	Class B	Class C
Total of all nuclides with <5yr	700		
H-3	40		
Co-60	700		
Ni-63	3.5	70	700
Ni-63 (activation, metals)	35	700	7000
Sr-90	0.04	150	7000

Cs-137	1.0	44	4600

(These concentration limits are based on intruder scenarios.)

ATTACHMENT 2. Presentation by Kristin Erickson, Michigan State University.

Ms. Erickson began her presentation by stating that she is in charge of Michigan State University's (MSU) Radiation Safety Services and also serves as MSU's radiation safety officer. The Nuclear Regulatory Commission (USNRC) requires that the facility's safety officer be named in the license and also, that the named individual meet the standards for credentials, experience and education. The officer is overseen by a committee appointed from the faculty. MSU's Radiation Safety Services program has a staff of five full-time and three part-time individuals.

Upon Michigan's departure from the Low Level Radioactive Waste (LLRW) Interstate Compact, federal and state agencies' inspections of LLRW storage facilities became more rigorous. The increased inspections made it even more necessary to ensure that the facilities kept their LLRW surveillance inventory and tracking programs updated. It was in response to this, in part, that MSU computerized its database in order to better manage its LLRW materials.

The inability to ship and dispose of waste for five years generated storage problems because of the lack of appropriate space and that made compliance difficult. When MSU was finally able to ship its wastes, it cost $3,000 per drum for disposal.

The nuclides used at large institutions like MSU are small quantities of short half-lived radioisotopes, which with proper handling, pose little to no threat to the handlers or the public. If any material is hotter than the ambient surroundings, modern instrumentation will detect it, therefore hiding waste is virtually impossible. At MSU, the dosimeter-wearing personnel have shown during the last five years an average exposure increase of less than 5 mrem/yr (2 mrem/yr to 4 mrem/yr) over ambient background. Badge monitoring is not required by law but MSU does it out of prudence. The ALARA (as low as reasonably achievable) radiation exposure for 1994 was at 10 mrem/yr well under the standard limit of 100 mrem/yr for the public. MSU also voluntarily does a thyroid scan once a week on personnel who handle radioactive material to help ensure that no one is being overly exposed. All persons coming in contact the waste in any manner must have 12 hours of instruction in radiation, radiation safety and hazardous waste, plus annual refreshers.

LLRW waste must be packed in such a way that a passerby will not receive a dose. All facilities must be fail-safe to any physical escape of radiation via its physical integrity or in another media and a running inventory must be kept on the stored materials and their decay rate. The US Department of Transportation also has rules and training for any persons transporting LLRW. All persons involved in handling or transporting LLRW must be certified in all phases associated with LLRW. The information on a tagged waste unit includes the amount of waste, the name of the isotope, the date bagged, the type and amount of accompanying chemicals, and tag number. A duplicate tag is maintained at the central office away from the storage site. All movement of waste is manifested and that activity added to the database. The records on each unit of waste are kept indefinitely.

The USNRC is very thorough in its inspections. There are different release limits for different isotopes by nuclide, based on the isotope's half-life. Some of the materials with long half-lives can be reused by a principal investigator at MSU. For the ten years that MSU has had a LLRW storage program, there have been no regulatory citations.

In addition to the storing of LLRW, MSU can hold and decay short-lived wastes down to background level and dispose of them as ordinary trash. Under its license, MSU can hold an isotope for ten half-lives, survey it and then release it. Some licenses are written for five half-lives. Most liquid wastes are in a non-polar solute form and lend themselves to incineration at a licensed facility. All disposal licenses are written specifically for that facility and specific waste isotopes. If disposal is a problem, a five year storage license is available and an additional application can be made to renew it for another five years. Some licenses are being renewed on request without application. Some wastes can be burned and the ash sent back to the generator, thus reducing the volume. A number of new technologies are being developed to handle LLRW including, molten metal separation, vitrification, glass imbedding, site freezing and super critical water oxidation. Sewer disposal has a number of confounding factor which make it undesirable. A suspect waste container containing unitized waste can be surveyed at the disposal site and each unit appropriately treated, but this classification should have been completed by the generator's laboratory. Super compaction eliminates the option of determining the composition of the mass at a latter date. The sophistication of the isotopes used in biological research has eliminated some of the problems experienced in the past.

Retrievability of each stored isotope is very important. Well calibrated Geiger counters and waste classification are basic to good LLRW management. A well organized and disciplined program, such as the one at MSU, is not dependent on any one person. MSU self manages most of its LLRW and has little use for the Barnwell site with the exception of some Cesium-137 waste.

Presentation Handout

Examples of Uses and Benefits to Society

* Medical uses
* Environmental research
* Physiology
* Microbiology and public health
* Energy
* Veterinary medicine and animal science
* Toxicology
* Food and agriculture
* Genetics
* Biochemistry
* Pharmacology and toxicology
* Engineering
* Waste management
* Physics

Impact of Lack of Disposal Access on Michigan Generators

* Increased cost
* Lack of space, storage problems
* Compliance problems; increased scrutiny by regulators
* Increased labor costs for surveillance and tracking
* Public relations problems
* Legal problems; time, expense and increases PR problems

Risks of Low Level Radioactive Waste at Universities

Nuclides are typically low risk and/or short half-life. Such institutions use decay or low risk as a way of maximizing health and safety, and minimizing waste problems. Use quantities are typically very low, as most methods in medical or research uses require low amounts for sensitivity of data and/or safety of patients and workers. Examples, Carbon 14, Phosphorus 32, Iodine 125, Tritium.

Many uses are in areas which are frequented by the general public, requiring stringent controls and safety features. Some uses involve students in classes.

Tracking is very easy with LLRW, since radioactivity is like a "smoking gun". If it is present, it can be detected and measured to very low levels with proper methods and instrumentation. Accurate numbers and tracking result in successful management programs.

Uses are very safe for workers and the general public. Michigan State University's person rem has remained beneath 5 millirem/year per worker for over 5 years.

Waste Management Methods and Options

* Decay and release
* Sewer disposal
* Shipment of deregulated or regulated liquids to licensed incinerators
* Incineration
* Compaction
* Minimization and Recycling
* Long Term Storage
* Off site storage or incineration and return
* Metal melting, vitrification, many other new technologies
* Off site survey, segregation, disposal of non-rad and return
* Treatment methods for mixed waste
* Shipping to national LLRW waste sites (Cost currently about $3,000/drum)

Regulatory Requirements for LLRW

* U.S. Nuclear Regulatory Commission (Federal law, Title 10 CFR, Parts 19,20 and 30)
* Institutional USNRC license; must describe programs and mechanisms to assure safety and compliance with Federal law
* U.S. Department of Transportation Title 49 CFR, extensive and detailed rules, recent and future changes affect radioactive materials transport
* U.S. Environmental Protection Agency, Resource Conservation and Recovery Act (Mixed radioactive waste), Title 40 CFR 61, Subpart I, NESHAPS being rescinded, mandates 10 mR/yr limit to general public.
* State of Michigan Ionizing Radiation Rules; Do not affect most of university uses. Rules in synchrony with USNRC rules in most areas.
* Occupational Safety and Health Administration; must abide by these rules where applicable.
* Federal Drug Administration; must abide by any applicable rules.
* Michigan Medical Waste Regulatory Act
* Michigan Act 64 (Resource Conservation and Recovery Act), mixed waste
* MOUs (Memos of Understanding) exist between USNRC and other federal agencies; inspectors are cross-trained. Efforts under way to synchronize and consolidate multiple and conflicting regulatory oversight; some progress has been made.

Functioning Program Components

* Must have license with U.S. Nuclear Regulatory Commission for LLRW management
* Must have Radiation Safety Officer, Radiation Safety Committee
* Must have proper facilities, including security (alarm systems), fire suppression
* Monitoring of waste and facility for contamination, airborne radiation, radiation levels
* Complete and accurate inventory of radioactive materials in building
* Training of all workers in all areas applicable as listed above
* Proper containment and packaging of radioactive waste
* Manifest of all containers on the container
* Bioassays of personnel who pick up, handle and process the waste
* Must keep records of waste picked up, stored, processed and disposed for review
* Must keep detailed records of all disposal streams to assure compliance with limits
* Sampling and analysis of liquid wastes and incinerator ash to assure compliance of tag manifests
* Inspection of waste in laboratories to assure proper manifest and tracking
* Must comply with occupational (5 rem/yr) and general public (100 mrem/yr) limits
* Effluents or potential releases may not exceed ALARA (As Low As Reasonably Achievable) levels; these are 10% of limits
* Must adhere to the maximum permissible concentrations for release listed in 10 CFR 20, Appendix B for individual of combined nuclides. This means exposures do not exceed general public limits.

MSU Program

* Segregation of nuclides by nuclide: release limits and half-life different for each

* Improved waste manifest tag
* Surveillance within laboratories, corrections required
* Sampling and analyzing liquid waste
* Screening and management in the approval process
* Aggressive education of generators; quantification, segregation, minimization, manifesting, chemical safety and hazardous waste. Initial training, annual refreshers, and continuous interactions with laboratories to reinforce good management techniques.
* Ash monitoring at incinerator
* Recycling program
* Waste building for decay in storage program, 10,000
* Computer program for tracking decay
* Cost of MSU program about $20,000/yr. and 1 technician
* No compliance problems. This program is economically cost efficient, compliant and safe.